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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/750,122	12/31/2003	Sang Hun Lee	42P17265	9798

7590 09/28/2005

George Chen
BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN LLP
Seventh Floor
12400 Wilshire Boulevard
Los Angeles, CA 90025

EXAMINER

ROSASCO, STEPHEN D

ART UNIT	PAPER NUMBER
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1756

DATE MAILED: 09/28/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/750,122	LEE, SANG HUN	
	Examiner	Art Unit	
	Stephen Rosasco	1756	

– The MAILING DATE of this communication appears on the cover sheet with the correspondence address –
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 14 May 2004.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-20 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-20 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 31 December 2003 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

Detailed Action

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1-20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chapman et al. (6,875,543) in view of Han et al. (US 2004/0091789 A1).

The claimed invention is directed to a structure and method comprising: providing a substrate, said substrate comprising a first region and a second region; forming a multilayer mirror over said substrate; forming a phase-shifter layer over said multilayer mirror; forming a capping layer over said phase-shifter layer; removing said capping layer and said phase-shifter layer in said second region; illuminating said first region and said second region with EUV light; and reflecting said EUV light off said first region and said second region.

And wherein said phase-shifter layer comprises molybdenum, and said capping layer comprises silicon nitride or carbon.

The applicant discusses the limitations of the prior art in that with the future, the direction of exposure wavelength will be to even shorter wavelengths, including extreme ultraviolet or EUV light. However, the EUV optics have lower NA than the DUV optics that are currently in use so RETs may have to be employed. Thus, what is needed is a

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phase-shifting mask for EUV photolithography and a method of forming such a phase-shifting mask for EUV photolithography.

Chapman et al. teach a method for fabricating a phase shifting mask for EUV lithography, wherein said mask comprises a substrate with a reflective multilayer coating attached thereto, the method comprising directly etching material away from said multilayer coating to produce a desired refractive phase shift in said mask, wherein the multilayer coating that was under the portion that was etched away is unchanged, wherein said desired phase change is equal to $4\pi(1-n)h/\lambda$, where h is the amount of material etched from the multilayer, n is the average refractive index of the multilayer and λ is the wavelength of light to be reflected.

And wherein the step of directly etching is carried out with an energy source selected from the group consisting of an ion beam, a laser beam, an atomic beam and an electron beam.

And wherein a desired pattern to be etched into the multilayer is transferred from a developed resist pattern on the multilayer surface by reactive ion etching.

And further comprising controlling the etching depth produced by the step of directly etching.

The teachings of Chapman et al. differ from those of the applicant in that the applicant teaches the use of a capping layer over said phase-shifter layer.

Han et al. teach a reflective mask useful for transferring a pattern to a semiconductor substrate comprising: a mask substrate; a lower multilayer reflective stack formed over the mask substrate; an etch stop layer formed on the lower

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multilayer reflective stack; an upper multilayer reflective stack formed over the etch stop layer; and an opening formed through the upper multilayer reflective stack and exposing the etch stop layer.

And further comprising an absorber layer formed over the etch stop layer within the opening.

And wherein the opening corresponds to a dark region; areas of the upper multilayer reflective stack adjacent the opening correspond to bright regions; the upper multilayer reflective stack defines a top plane of the reflective mask; and the thickness of the absorber layer is chosen so that reflection of EUV radiation at the top plane within the opening is 3-20 percent of reflection of EUV radiation at the top plane within the upper multilayer reflective stack.

And wherein the lower and upper multilayer reflective stacks each comprise periods of alternating layers of different materials, and wherein a number of periods for each of the lower and upper multilayer reflective stack is determined, at least in part, by a requirement that EUV radiation reflected in the dark region is approximately 180 degree out of phase with respect to EUV radiation reflected in the bright region.

Han et al. also teach that it is preferable that the materials chosen for the upper reflective stack 22 are more easily etched than those of the bottom reflective stack 14, if different materials are used for the upper reflective stack 22 and the lower reflective stack 14. In addition, a capping layer can optionally be formed over the upper reflective stack 22 to protect the materials in the upper reflective stack 22 against oxidation.

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It would have been obvious to one having ordinary skill in the art to take the teachings of Chapman et al. and combine them with the teachings of Han et al. in order to make the claimed invention because it would have been obvious to one to use a capping layer for more precision masks such as the EUV mask, because it is known in the art to use a capping layer for protection as taught by Han et al.

Conclusion

Any inquiry concerning this communication or earlier communications from the Examiner should be directed to Stephen Rosasco whose telephone number is (571) 272-1389. The Examiner can normally be reached Monday-Friday, from 8:00 AM to 4:30 PM. The Examiner's supervisor, Mark Huff, can be reached on (571) 272-1385. The fax phone number for the organization where this application or proceeding is assigned is (571) 273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

A handwritten signature in black ink, appearing to read 'S. Rosasco', with a stylized initial 'S'.

S. Rosasco
Primary Examiner
Art Unit 1756

S. Rosasco
09/22/05